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ABSTRACT

This study followed one preservice teacher, Liz, as she progressed through her senior year of a secondary mathematics education program that illustrated and encouraged views congruous with the National Council of Teachers of Mathematics (NCTM) "Standards." At the start of the program Liz saw her role as one in which it was her responsibility to create a classroom environment defined to be non-intimidating, non-frustrating, interesting, and motivating for her students. Throughout the year, her beliefs defining her role of teacher were strengthened by the program. In addition, a belief in the use of problem-solving activities evolved from her beliefs of her role of teacher. This belief in problem-solving activities, combined with her student teaching experience caused Liz to re-examine some of her earlier beliefs. (Author/MKR)

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The Developing Role of Teacher: One Preservice Secondary Mathematics Teacher's Beliefs and Experiences

Jennifer Chauvot and Pamela Turner

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(17th PME-NA, Columbus, OH, October 21-24, 1995)

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THE DEVELOPING ROLE OF TEACHER: ONE PRESERVICE SECONDARY MATHEMATICS TEACHER'S BELIEFS AND EXPERIENCES

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This study followed one preservice teacher, Liz, as she progressed through her senior year of a secondary mathematics education program that illustrated and encouraged views congruous with the NCTM *Standards*. At the start of the program Liz saw her role as one in which it was her responsibility to create a classroom environment defined to be non-intimidating, non-frustrating, interesting, and motivating for her students. Throughout the year, her beliefs defining her role of teacher were strengthened by the program. In addition, a belief in the use of problem-solving activities evolved from her beliefs of her role of teacher. This belief in problem-solving activities paired with her student teaching experience caused Liz to re-examine some of her earlier beliefs. We will follow Liz into her first year of teaching to see how or whether this evolution continues.

Preservice teachers enter mathematics education programs with preconceived notions or ideas about the role of teacher in the classroom. As mathematics education programs continue to implement and encourage the underlying ideas and concepts espoused by the NCTM *Standards* (1991), preservice teachers are encouraged to develop and identify their role as teacher. Their initial notions, often constructed through their own classroom experiences, are the beginning of a more structured development and identification of beliefs about teaching. This study was conducted as part of the Research and Development Initiatives Applied to Teacher Education (RADIATE)[1] project. We followed one preservice teacher, Liz, as she progressed through her senior year of a mathematics education program that illustrated and encouraged views congruous with the NCTM *Standards*. At the start of the program Liz saw her role as one in which it was her responsibility to create a classroom environment defined to be non-intimidating, non-frustrating, interesting, and motivating for her students. Throughout the program her beliefs defining her role of teacher were strengthened. In addition, a belief in the use of problem-solving activities evolved from her beliefs of her role of teacher. This new belief combined with earlier notions and her student teaching experience, caused Liz to re-examine some of her earlier beliefs.

We used Green's (1971) theory of belief systems to help us organize and understand Liz's beliefs and how they were structured. Considering a quasi-logical structure, Green described beliefs as either derivative or primary. A derivative belief is a belief that follows from, or is derived from other beliefs. For example, a teacher may have a belief of frequent use of cooperative learning. The teacher

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may argue that this belief followed from a belief that one needs to be able to function as part of a team to be successful in the real world. If the teacher cannot provide a reason, or argues "it just is", then the belief is described as primary.

Psychologically, beliefs are either central/core or peripheral. Green used concentric circles as a model in which the interior circles represent psychologically central beliefs and the exterior circles represent psychologically peripheral beliefs. The teacher's teamwork belief (to do well one must be part of a team) may be held centrally, or psychologically strong. On the other hand, the belief may be held peripherally to a core belief that the teacher must prepare students to do well in the real world. If it is held peripherally, then it is not held as strongly and is more likely to be examined and perhaps changed.

Green (1971) uses evidentially and nonevidentially held beliefs to describe grounds of beliefs. A belief held nonevidentially is less apt to be modified despite evidence or reasons provided. The teacher may believe that teamwork is the way to go regardless of the success of individual workers. Evidentially held beliefs however are more susceptible to modification. They can be changed through the introduction of more evidence, for example, success of individual workers.

Methodology

Liz, one of fifteen preservice teachers of the RADIATE program, participated in two mathematics education courses, a practicum, one quarter of student teaching, and a post student teaching seminar. She was chosen for this study because of her willingness to participate and share her views on teaching and learning. Data collection came from several sources. At the start of the study, Liz completed an initial survey that asked her to reflect on her views of mathematics and her views of the teaching and learning of mathematics. She submitted journal entries weekly the first, second and fourth quarter. Journal questions focused on reflections of course experiences, how they related to herself and to her teaching. Coursework artifacts (papers, exams) and student teaching artifacts were also collected. Nine audiotaped interviews were conducted throughout the year, one of which was a card-sort interview. For the card sort Liz highlighted passages from her first seven interviews that she felt were important. She defined "important" to be what she thought was valuable. Her choices were placed on cards and she was then asked to sort them into categories which she defined. Lastly, Liz was observed in separate field experiences: team-teaching a technology enhanced lesson, team-teaching a week long unit, and her ten week student teaching assignment.

Liz's Developing Role of Teacher

Liz entered the program with many notions of teaching in mind. She described the characteristics of a good mathematics teacher as follows.

> A good mathematics teacher can explain one problem in several ways, can deviate from the lesson plan to meet the needs of his/her students, can help the students visualize with the use of dia-

> grams or props, can vary teaching to increase interest and motivation, can spend extra time with students, is patient and flexible, verifies comprehension before leaving one topic, is aware of his/her body language and comments toward students in order to not disencourage [sic] students from learning, is comfortable with his/her mathematical knowledge, is always properly prepared to teach. (initial survey, 3/29/94)

In the first interview, Liz reiterated these characteristics and stressed the responsibility of the teacher to behave in the above manner. From this, we began to identify some of Liz's beliefs about teaching, specifically her beliefs about her role of teacher. A core belief seemed to be that it was her responsibility to create a classroom environment that demonstrated the above characteristics. This classroom environment was defined by three other beliefs: students should not be intimidated or embarrassed, students should not be frustrated, students should be kept interested and motivated. These four beliefs and Green's (1971) theory helped us understand Liz's reflections and actions as she shared her perception of her role of teacher.

Liz based her three beliefs defining the environment on her experiences as a student in the classroom. She made references to classes where the instructor had been intimidating, material was not explained clearly (causing frustration), and to classes that were boring. These served as counterpoints and defining elements of what she considered good teaching to be.

Liz's role of teacher became more and more defined as she expressed how she would fulfill her responsibilities. For her, the creation of a classroom where students did not feel intimidated could be achieved using the following strategy.

> If the teacher, on the first day, randomly picked someone to come up front and do a problem on the board and you know, do this. And if they embarrass themselves, it's no problem. You just keep going and, you know, everyone's going to get the chance to embarrass themselves. And it just becomes that kind of environment ...it encourages questions and someone's more liable to raise their hand and say, "I'm confused." You know? (1st quarter interview 4/7/94)

This strategy remained consistent throughout our year with Liz. This belief that students should not be intimidated seemed centrally held and had a primary structure (Green, 1971). It was not subject to change. To Liz it was common sense to believe that part of an ideal classroom environment would include students who did not feel intimidated or embarrassed to ask questions.

It was also common sense to believe that students should not feel frustrated in a classroom. Liz had two strategies that fulfilled this belief which again helped define her role of teacher. The first was for the teacher to demonstrate flexibility. Flexibility was defined to be an ability to "deviate from the lesson plan to meet the needs of his/her students". This was, of course, contingent upon students' willing-

ness to ask questions. Liz expressed this belief throughout the year and demonstrated it while she was student teaching. (The text in italics represents passages Liz highlighted in the card sort interview.)

> I was gonna go over everything again before I talked about standard error. But umm they, they, it sounded like they knew what they were doing so I went ahead to standard error and we covered everything and they were ready to try out what they knew. And um, so I was, it ended up being a lot more organized 'cause when I started, *the lesson was all dependent on what they remembered from the day before.* (student teaching interview, 2/23/95)

Flexibility had been a part of her plan. She would not have gone on with new material had her students expressed confusion. Her second strategy to reduce frustration of her students was to present and explain material clearly. She demonstrated this consistently throughout the program. Her mathematics education courses included several activities which were open-ended and provided limited direction. In reflecting on such activities and how or if they would be used in her classroom, Liz consistently modified the activities to provide more direction. This belief of providing direction appeared to be peripherally held, contingent on the level of student. In her second interview she mentioned different approaches for different level students. She was asked to elaborate.

> Uhm, for the advanced students, probably more challenging, more individual or group work that doesn't show as much an objective and they figure it out for themselves. The general classes, maybe more give them a lead, give them an objective of what we're working on so that they're going in the right direction, you know, they can still work on the problem solving *but they're at least led in the right direction kind of because I feel like they're more likely to maybe get discouraged and quit rather than the advanced student.* (1st quarter interview, 5/24/94)

However, student teaching data did not illustrate this differential treatment. Although activities in the higher level courses that Liz taught were open-ended explorations, handouts she provided with the activities were very structured and leading. This suggested that perhaps she held her belief of low frustration levels of her students more strongly than we thought, representing a core belief (Green, 1971).

According to Liz, her third belief in defining her ideal classroom environment, students should be kept interested and motivated, could be fulfilled by varying her teaching styles. In the fourth interview, Liz discussed the use of lecture.

> *I think that sometimes that that's the best way depending on your time, the size of your group, and everything, and the material you have to teach, then I think that that could easily be the best way. Also I think it's good to vary the way you teach just the*

> *same.* I mean I think if they get used to activities and how you're gonna test them and everything, then they can easily get into that group and start slacking so you know? *If they never know what they're gonna get when they come into the room, it's probably a little better.* (2nd quarter interview, 10/13/94)

Although Liz's experiences as a student were mostly in classrooms that had been teacher-centered and textbook-based, Liz was very receptive to the multiple teaching styles demonstrated in the program. We suspect her belief of keeping the classroom environment interesting and motivating, coupled with mathematics education course experiences, provided a catalyst for a belief in the use of group work in the classroom.

> It's easy to just get drawn into the normal way of presenting the material, teaching it step by step you know. The normal, what the book says, the books suggestions of teaching it...but I would like to throw in group activities and more exploration on the student's part...*I think it definitely helps their learning a lot so (pause) cause it's helped mine just in our class.* (1st quarter interview 5/24/94)

Related to this belief in group work was a simultaneously evolving belief in problem solving. It began with her view on word problems.

> I really do like word problems, but as far as that being the main point of it, I think that the students, if they learn their math they're going to be able to apply it...I don't think that it has to be a number one stress in the classroom. (1st quarter interview 4/7/94)

At the start of the program, the terms *word problems* and *problem solving* were interchangeable. Her belief in word problems seemed to be evidentially held in that she was successful in her mathematics courses, and word problems did not play a significant role in this success. She was also working under the assumption that her students would learn the same way she did. However, as the program progressed, more experiences forced her to re-examine her beliefs. She began to realize not everyone is the same as she, word problems and problem solving are different, and there is a lot to gain from problem-solving activities.

> I probably will not be teaching many students with my perspective of math [enjoyment, success]. By observing at [a local high school], I am learning the different students' perspectives...I have learned that what worked with me will not necessarily work with everyone. (1st quarter journal 5/10/94)

At the end of the first quarter, she differentiated between the terms "word problems" and "problem solving." Word problems were what she encountered as a

high school student - problems with words at the end of each chapter. Those problems were routine once you extracted the information. However,

> [Problem solving is] *more like you have to think of your own method of doing it* [not just follow the directions]...[problem solving] *is really important to just sort of bring everything together for the students to see how it connects and how it's not just being used, you know, in one specific area, that it can be applied to other things and that all the concepts can be put together to solve a large problem, you know, that they work over a period of time...* (1st quarter interview, 6/2/94)

Time constraints of using problem-solving activities and covering school curriculum were a consideration. Her practicum experience, which occurred between the first and second quarter, allowed her to see group work and problem-solving activities in action. "*I was sold 100% because they learned more from that than it looked like they were learning from lecture*" (2nd quarter interview, 10/13/94). This acceptance of the use of problem-solving activities was easily derived from her belief of keeping the classroom interesting and motivating. Not only that, but Liz's concern about time constraints was diminishing by the end of her student teaching experience. Under the guidance of her cooperating teacher, she saw flexibility in the curriculum.

> *We've got two weeks to teach these three main topics that we'll expand into other stuff and overlap through activities. So suddenly it was like I've got more than enough time to do this.* (4th quarter interview, 4/20/95)

Problem solving was the largest of ten categories Liz formed in the card sort interview. Over 20% of her cards were placed in this category. She saw problem solving as mathematics that was not contained in school mathematics, but she would be sure to include it in her teaching. In the last quarter, Liz defined problem solving as the heart of mathematics. She added "if you have good problem-solving skills, then you can tackle a lot of things mathematically as well as in other areas" (4th quarter interview, 5/30/95).

Liz's view of problem solving interacted with her belief in her role of providing direction to her students. In problem-solving activities her role was to "*point them in a direction...but not tell them where to go with it...*" (student teaching interview, 2/23/95). Her belief in *how much* direction to provide was unstable, peripherally held to the core belief of keeping her students from being frustrated. Lack of direction on the teacher's part will cause confusion and frustration in the students. During student teaching, it was brought to her attention that perhaps she was providing too much direction.

> Well I don't realize when I'm doing that, but uh my cooperating teacher kept thinking that I did, you know? *That I was giving them too much direction where they're going, but I guess that's*

> *just getting to know your students and knowing what they're capable of doing, you know?....[I need] to find a balance. Give them just enough direction so that they feel like they have found their answer on their own and they feel confident...But then not giving them too little so they don't get frustrated.* (4th quarter interview, 4/20/95)

Liz was examining her belief in providing direction for her students and how it related to her belief in problem-solving activities. We will follow Liz into her first year of teaching to see how these two beliefs continue to interact.

Final Comments

Green's (1971) theory of belief systems provided a perspective for organizing the structure of Liz's beliefs of her role of teacher in the classroom. This in turn helped us consider experiences that promoted modification of her beliefs. If we are receptive to preservice teachers' beliefs as they enter mathematics education programs, we may provide catalysts that could promote change and growth in beliefs congruous with the NCTM *Standards*.

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